OBSERVATIONS ON THE FOOD AND GROWTH OF JUVENILE AMERICAN SHAD, *ALOSA SAPIDISSIMA*[1]

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ABSTRACT

Previous studies on the food habits of juvenile American shad have been restricted to one area such as an individual river or a group of ponds. In this study juveniles were obtained from six widely separated rivers. It was found that the food taken, mostly insects and crustaceans, was approximately the same in all rivers sampled. In general young shad appeared to utilize those food organisms which were most available in their habitat at a particular time. Phytoplankton was not observed in any of the 453 stomachs examined. The average lengths of the shad sampled from the various rivers, excluding the Pamunkey River sample, were similar although the southern river samples spawned earlier than those from the more northern rivers.

INTRODUCTION

The American shad *(Alosa sapidissima)* is an anadromous fish that spends most of its life in the sea. Each spring the sexually mature adults return to their native stream to spawn. The new year-class spends its first summer and early fall in the river and then returns to the ocean. Details on the life history of shad can be found in the papers of Leim (1924).

During August, 1954, juvenile shad were obtained from several rivers along the Atlantic Coast to determine if there were differences in average growth and types of food taken. A sample of shad was also taken in October at one of the stations. To the author's knowledge no previous coast-wise comparison of this type has been made. Mitchell and staff (1925), examined the stomachs of young shad taken from the Connecticut River and a nearby pond and concluded that insects and crustaceans were the mainstay of the diet. Leim (1924) examined the stomach contents of 40 juvenile shad, 24-25 millimeters in length, taken from the Shubenacadie River in Nova Scotia. Their food consisted mainly of plankton such copepods, amphipods, cladocerans, insect larvae, ostracods,

[1]The shad investigation of the U. S. Fish and Wildlife Service, of which this study is a part, is being carried on to furnish information for fishery regulations to the Atlantic States Marine Fisheries Commission.

and water mites. Maxfield[2] studied the food habits of juvenile shad reared in ponds in Maryland and found that the major food items were ostracods, insects, insect larvae, copepods, and cladocerans.

Sampling Methods

The rivers sampled in this study were the St. Johns in Florida, the Ogeechee in Georgia, the Neuse in North Carolina, the Pamunkey in Virginia, the Hudson in New York and the Connecticut in Connecticut. Samples were obtained with a surface trawl similar to that described by Massmann, Ladd, and McCutcheon (1952) in all the rivers except the Hudson River where a portion of the sample was obtained with a 20-foot beach seine. The trawl sampling was done after sunset because daylight trawling yielded few shad.

Specimens were removed from the net and preserved in 10-percent formalin. The majority of young shad had suffocated before their introduction into formalin and therefore, regurgitation of stomach contents was at a minimum. Samples were taken to the laboratory where specimens were measured (fork length in millimeters) and the stomachs were removed at random from one-half the individuals in each sample. It was assumed that the results obtained through the study of one-half the sample would be representative of the food taken by the entire sample. Samples from each river were kept separate. Stomach contents were examined with a binocular microscope. In all 453 stomachs were examined, each of which contained some type of food.

Food of Juvenile Shad

In this study the frequency-of-occurrence method was used to express the type of food present. The percentage of stomachs in each sample containing a given organism is tabulated in Table 1. Frequently copepods, cladocerans, and many of the insects were considerably broken up and often only a portion of the bodies of food animals could be found. This often made complete identification difficult or impossible.

The St. Johns River sample was taken from three locations; Lake Monroe, Georgetown, and Mandarin. The stomachs from this sample which were examined contained little food. The food taken consisted of ostracods, hymenopterans, insect larvae and unidentifiable insects. Marine decapod larvae were found only in the sample taken at Mandarin, which is nearer to salt water than the other locations. Ostracods were noticeably absent from this latter sampling location.

The stomachs obtained from the Ogechee River fish contained little food. The material found in them consisted mainly of unidentifiable insects and animal residue, plus cladocerans and marine decapod larvae.

[2]Maxfield, C. H. 1952. The food habits of hatchery-produced pond-cultured shad (Alosa sapidissima) reared to a total length of two inches. Masters Thesis, Univ. of Wash.

In the August sample from the Neuse River there was much variation in the type of food taken as well as the amount of food found in the individual stomachs. Crustacean eggs and mayflies made up the bulk of the identifiable material. The Neuse River sample taken in October indicated a much different diet from that found earlier. Stomach contents of fish in the fall sample consisted almost exclusively of insects, excluding Ephemerida. Unidentifiable small fish were also present in some of the stomachs; small cyprinid minnows and anchovies (*Anchova* sp.) 10 to 20 millimeters in length. Mitchell and staff (1925) also reported finding small fish—various minnows, small sunfish (*Lepomis* sp.) in the stomachs of young shad. The occurrence of fish in 24 percent of the October collections from the Neuse River indicates that the ability of juvenile shad

TABLE 1.—*Frequency of occurrence of various food items in stomachs of juvenile shad, expressed as percentage of number of fish examined*

Location	St. Johns River	Lake Monroe	Georgetown	Mandarin	Ogeechee River	Neuse River	August sample	October sample[1]	Pamunkey River	Hudson River	Surface trawl	Beach seine	Connecticut River	Below Enfield Dam	Above Enfield Dam
Type of food															
Decapod larvae	—	—	—	38	17	—	2	13	5	—	—	—	—	—	—
Copepoda	—	12	7	4	—	—	—	7	—	—	28	3	—	57	100
Ostracoda	—	47	93	—	—	—	14	—	22	—	24	—	—	2	7
Cladocera	—	6	—	42	20	—	4	—	—	—	4	—	—	76	84
Crustacean eggs	—	12	7	4	—	—	27	6	3	—	4	13	—	60	42
Ephemerida	—	—	—	—	—	—	25	—	74	—	—	—	—	—	5
Homoptera	—	—	—	—	—	—	2	54	—	—	—	33	—	—	—
Hemiptera	—	—	—	—	5	—	—	4	—	—	—	13	—	—	—
Hymenoptera	—	65	50	13	—	—	8	85	4	—	8	17	—	12	5
Coleoptera	—	—	—	—	6	—	—	17	1	—	—	13	—	—	—
Diptera	—	—	—	—	8	—	4	48	—	—	36	80	—	42	32
Diptera larvae	—	—	—	—	—	—	—	4	1	—	32	77	—	—	—
Diptera pupae	—	—	—	—	—	—	—	4	1	—	—	23	—	14	—
Insect eggs	—	—	—	—	—	—	—	—	59	—	—	—	—	—	—
Unidentifiable insects[2]	—	24	57	38	28	—	20	15	18	—	60	37	—	43	26
Miscellaneous insect larvae	—	35	36	21	11	—	8	—	—	—	—	—	—	67	5
Nematoda	—	—	—	—	6	—	—	—	25	—	8	20	—	21	—
Unidentifiable animal remains	—	—	—	—	22	—	22	—	4	—	—	—	—	—	—
Araneida	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—
Fish	—	6	—	—	—	—	—	24	1	—	—	—	—	—	—
Fish larvae	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Number of stomachs examined	—	17	14	24	65	—	51	54	112	—	25	30	—	42	19

[1]This sample was taken at the same location as the August sample.
[2]Partially digested.

to take fish as food may increase with an increase in length. The mean length of the 98 juvenile shad collected in August from the Neuse River was 51 millimeters (range 35-83) while that of the 55 juveniles collected in October from this same river was 75 millimeters (range 62-93).

The stomachs of young shad taken from the Pamunkey River were generally full. The main diet at the time of sampling was Ephemerida and insect eggs. Nematoda and Ostracoda were also well represented in the sample.

The Hudson River trawl sample was taken in a cove where the water averaged about six feet in depth. The stomachs of these shad contained little food while those from the shore-seine sample were full. The sample from the cove contained ostracods, copepods, and insects while insects made up most of the food in the beach area.

The sample from the Connecticut River was taken both above and below Enfield Dam near Thompsonville, Connecticut. The stomachs of the shad taken from the impounded area were full and the food consisted of copepods and cladocerans and a few insects. The sample from below the dam showed a preponderance of insects and insect larvae with few crustaceans.

It is evident from the data that the diet of juvenile shad is diversified. Insects and crustaceans seem to be the main dietary items in rivers but the food differs somewhat in any river and in different rivers. Apparently juvenile shad will utilize those food organisms which are most available in the habitat at a particular time. Phytoplankton was not observed in any of the 453 stomachs examined in this study. This finding is in agreement with Maxfield[2] who stated that the absence of algae in the digestive tracts suggests that young shad seek out zooplankton in preference to phytoplankton as food.

Growth of Juvenile Shad

The fork length was determined for all shad in each sample and averages and ranges of these measurements are shown in Table 2. Assuming that

TABLE 2.—*Length of juvenile shad taken from several Atlantic Coast rivers, 1954*

River	Date of collection (August)	Number of fish taken	Fork length (millimeters)	
			Range	Average
St. Johns	9-11	112	39-74	54
Ogeechee	13	130	42-76	55
Neuse	17-18	98	35-83	51
Pamunkey	20-23	223	47-85	65
Hudson	29	110	45-65	54
Connecticut	27-28	217	37-84	54

the sample from each river was representative and a true indication of juvenile-shad growth, comparisons of growth in the different rivers can be made. In the Pamunkey River juvenile shad were of a larger average size (65 millimeters) and in the Neuse River of a smaller average size (51 millimeters) than in the other streams. In the other streams the average lengths of the fish in August were 54 and 55 millimeters. Similarity of average lengths in the different rivers was unexpected because the peak of shad spawning in the St. Johns River is in March, whereas the peak in the Connecticut River occurs in May.[3] On the basis of age alone, an increase in average length from north to south would be expected. Apparently environmental factors may cancel out growth differential which might be expected from differences in spawning dates.

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[3]Unpublished data U. S. Fish and Wildlife Service, Beaufort, N. C.